Health and Wealth: the challenge of the gradient

Michael Marmot
Director
International Institute for Society and Health

The Royal Swedish Academy of Sciences
May 29th 2007
The gradient
Poverty?
Not inevitable
Selection?
Causal pathways
Action
The gradient
Poverty?
Not inevitable
Selection?
Causal pathways
Action
MORTALITY OVER 25 YEARS ACCORDING TO LEVEL IN THE OCCUPATIONAL HIERARCHY: WHITEHALL

(Marmot & Shipley, 1996)
Mortality over 25 years according to level in the occupational hierarchy: Whitehall

(Marmot & Shipley, BMJ, 1996)
Self-reported physical health in older people: WII study

Chandola et al 2007
Poor self-rated health at age 50+ and accumulation of socio-economic risk factors over life course in Russia

Risk factors:
• Ever hungry to bed aged 15 yr
• Elementary /vocational education
• Adult household income below median

(Nicholson et al)
MEN AGED 64 IN 1990 WHO DIED UP TO 1996 BY EDUCATION SWEDISH NATIONAL SAMPLE

Erikson 2001
MORTALITY* AND EDUCATION, SOUTH KOREA

*Mortality in Korean working population aged 20-64, 1993-1997, adjusted for age
(Source: Son et al. JECH 56:798, 2002)
Oscar winning actors and actresses lived an astonishing 4 years longer than their co-stars and the actors nominated who did not win. (Redelmeier & Singh)

Winning the Oscar is like reducing your chance of dying from a heart attack from about average to zero.

Status Syndrome
Change in Life Expectancy at age 25 by Educational Level 1989-2000 in Estonia

The widening trend in mortality by education in Russia, 1989-2001

45 p20 = probability of living to 65 yrs when aged 20 yrs

Source: Murphy et al, AJPH, 96, 1293-9, 2006
LIFE EXPECTANCY AT AGE 15 IN EUROPE, MEN, 1970-2001
The gradient
Poverty?
Not inevitable
Selection?
Causal pathways
Action
## LIFE EXPECTANCY AT BIRTH

<table>
<thead>
<tr>
<th>Region</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indigenous Australian*</td>
<td>59.4</td>
<td>64.8</td>
</tr>
<tr>
<td>Non Indigenous Australian*</td>
<td>76.6</td>
<td>82.0</td>
</tr>
<tr>
<td>India**</td>
<td>61.8</td>
<td>65.0</td>
</tr>
<tr>
<td>Russia**</td>
<td>59.0</td>
<td>72.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Infant Mortality per 1000 Live Births</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aboriginal*</td>
<td>12.7</td>
</tr>
<tr>
<td>Australian</td>
<td>5.2</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>181</td>
</tr>
<tr>
<td>Iceland</td>
<td>3</td>
</tr>
</tbody>
</table>

*Aboriginal and Torres Strait Islanders*
# GDP PER CAPITA AND LIFE EXPECTANCY: SELECTED COUNTRIES

<table>
<thead>
<tr>
<th>Country</th>
<th>GDP PER CAPITA (PPP US$)</th>
<th>LIFE EXPECTANCY AT BIRTH (MALES)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRI LANKA</td>
<td>3,778</td>
<td>68</td>
</tr>
<tr>
<td>COSTA RICA</td>
<td>9,606</td>
<td>75</td>
</tr>
<tr>
<td>RUSSIA</td>
<td>9,230</td>
<td>58</td>
</tr>
<tr>
<td>CHILE</td>
<td>10,274</td>
<td>74</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>LE at birth</th>
<th>GDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Japan</td>
<td>82.2</td>
<td>29,251</td>
</tr>
<tr>
<td>Switzerland</td>
<td>80.7</td>
<td>33,040</td>
</tr>
<tr>
<td>Sweden</td>
<td>80.3</td>
<td>29,541</td>
</tr>
<tr>
<td>Spain</td>
<td>79.7</td>
<td>25,047</td>
</tr>
<tr>
<td>France</td>
<td>79.6</td>
<td>29,300</td>
</tr>
<tr>
<td>UK</td>
<td>78.3</td>
<td>30,821</td>
</tr>
<tr>
<td>Greece</td>
<td>78.3</td>
<td>22,205</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>78.3</td>
<td>9,481</td>
</tr>
<tr>
<td>Chile</td>
<td>78.1</td>
<td>10,874</td>
</tr>
<tr>
<td>Cuba</td>
<td>77.6</td>
<td>5,700</td>
</tr>
<tr>
<td>US</td>
<td>77.5</td>
<td>39,676</td>
</tr>
</tbody>
</table>

(Human Development Report 2006)
Changes in RII for income and wealth on *poor self-rated health* among men and women after adjustments: WII

Martikainen et al, 2003
Coronary events by economic difficulties: WII
(adjusted for age)

Relative hazard ratio between the bottom and the top hierarchies: 2.8 (1.9-2.4)
P-value for RII: < 0.001

Ferrie et al, 2005
Hazard ratios for RII for economic difficulties and coronary events after adjustments

<table>
<thead>
<tr>
<th>Adjustments</th>
<th>Total coronary events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>2.80 (1.9-4.2)</td>
</tr>
<tr>
<td>Model 1: age + SES measures</td>
<td>2.67 (1.7-4.1)</td>
</tr>
<tr>
<td>Model 2: model 1 + early life factors</td>
<td>2.70 (1.8-4.1)</td>
</tr>
<tr>
<td>Model 2 + psychosocial work characteristics</td>
<td>2.56 (1.7-3.9)</td>
</tr>
<tr>
<td>Model 2 + health-related behaviours</td>
<td>2.60 (1.7-4.0)</td>
</tr>
<tr>
<td>Model 2 + biological factors</td>
<td>2.42 (1.6-3.7)</td>
</tr>
<tr>
<td>All</td>
<td>2.28 (1.5-3.5)</td>
</tr>
</tbody>
</table>

Ferrie et al, 2005
The gradient
Poverty?
Not inevitable
Selection?
Causal pathways
Action
Life expectancy at birth for men by social class in England and Wales

Source: Donkin, Goldblatt, and Lynch 2002
Life expectancy at age 30 by education for men in the US

Years

Source: Crimmins and Saito 2001
The widening trend in mortality by education in Russia, 1989-2001

45 p20 = probability of living to 65 yrs when aged 20 yrs

Source: Murphy et al, AJPH, 96, 1293-9, 2006
Mortality for non-manual and manual workers in nine European countries
Ranked by absolute level of mortality of manual workers; age groups 45-59
The gradient
Poverty?
Not inevitable
Selection?
Causal pathways
Action
Correlation between adult health and adult SES when health related mobility path is removed: -0.02

Social causation path is removed: -0.02

Both cross lagged paths are removed: -0.02

The correlation between adult social class and adult health among men in the 1958 NCDS cohort reduced from -0.19 to -0.07 when adjusted for educational qualifications, father’s social class and cognitive ability. Adolescent health (at age 16) did not contribute to reducing the social gradient in adult health.
The gradient
Poverty?
Not inevitable
Selection?
Causal pathways
Action
Causation

- Life course
- Behaviours
- Medical care
- Control
- Social supports
- Biology
Whitehall II – Is education related to health?

Multiple regression

Path analysis

Source: Singh-Manouxx, Clarke & Marmot
Multiple measures of socio-economic position and psychosocial health: proximal and distal measures; Int. J. Epidemiol. 31: 1192-1199.
CHD death/MI incidence in 10 years by grade and height: M Whitehall II

![Bar chart showing CHD death/MI incidence by employment grade and height.](chart)

- **Employment Grade:** High, Middle, Low
- **Height:** Tall, Middle, Short
- **Rate/100,000 pyar:**
  - High: Tall > Middle > Short
  - Middle: Tall = Middle > Short
  - Low: Tall > Middle > Short

The chart illustrates a clear trend where the rate of CHD death/MI incidence increases with lower employment grades and shorter height.
Causation

- Life course
- Behaviours
- Medical care
- Control
- Social supports
- Biology
controlling for (a) age, and (b) age, smoking systolic blood pressure, plasma cholesterol concentration, height and blood sugar
Causation

- Life course
- Behaviours
- Medical care
- Control
- Social supports
- Biology
## Total expenditure on health as % of GDP (2003)

<table>
<thead>
<tr>
<th>Country</th>
<th>%</th>
<th>LE at birth 2004 (both sexes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>15.2</td>
<td>78</td>
</tr>
<tr>
<td>UK</td>
<td>8</td>
<td>79</td>
</tr>
<tr>
<td>Cuba</td>
<td>7.3</td>
<td>78</td>
</tr>
<tr>
<td>Japan</td>
<td>7.9</td>
<td>82</td>
</tr>
<tr>
<td>Sweden</td>
<td>9.4</td>
<td>81</td>
</tr>
<tr>
<td>Iceland</td>
<td>10.5</td>
<td>81</td>
</tr>
</tbody>
</table>
EXPENDITURE ON MEDICAL CARE PER CAPITA IN US AND UK

UNITED STATES:
– US$ 5274

UNITED KINGDOM:
– US$ 2164 (adjusted for purchasing power)

(Human Development Report 2005)
HEALTH DIFFERENCES BETWEEN ENGLAND AND THE US

55-64 year olds

% Prevalence

Low income  Middle income  High Income

Heart disease  Diabetes  Cancer

Source: Banks, Marmot, Oldfield and Smith; JAMA 2006
Medical care (revascularization) and employment grade: Whitehall II

Britton et al BMJ: 329, 381, 2004
Shively, 1999
Causation

- Life course
- Behaviours
- Medical care
- Control
- Social supports
- Biology
SELF-REPORTED JOB CONTROL AND CHD INCIDENCE WHITEHALL MEN AND WOMEN

- Adjusted age, sex, length of follow up
- + effort/reward imbalance
- + grade, coronary risk factors, negative affect

Bosma et al, 1998
EFFORT-REWARD IMBALANCE AND CHD WHITEHALL II

*Adjusted for age, sex and grade

(Kuper et al. 2002, Occup Environ Med, 59, 777-784)
Adjusted hazard ratios for cardiovascular mortality by levels of work stress^#

Nmax=812 (73 deaths); mean follow-up 25.6 years

<table>
<thead>
<tr>
<th>Tertiles</th>
<th>1 = low;</th>
<th>2 = intermediate;</th>
<th>3 = high</th>
</tr>
</thead>
<tbody>
<tr>
<td>High demand / low control</td>
<td>*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Effort-Reward Imbalance</td>
<td>*</td>
<td>*</td>
<td></td>
</tr>
</tbody>
</table>

^adj. for age, sex, occupational group, smoking, physical activity, SBP, total chol., BMI

Source: M. Kivimäki et al. (2002), BMJ, 325: 857
Meta-analysis

Work stress is associated with a 50% excess risk of coronary heart disease

<table>
<thead>
<tr>
<th>Model</th>
<th>N</th>
<th>HR (age- &amp; sex-adjusted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Job strain</td>
<td>83 014</td>
<td>1.45</td>
</tr>
<tr>
<td>ERI</td>
<td>11 528</td>
<td>1.58</td>
</tr>
<tr>
<td>Injustice</td>
<td>7 246</td>
<td>1.47</td>
</tr>
</tbody>
</table>

Kivimäki et al. Scand J Work Environ Health 2006
PAR* for coronary heart disease (fatal CHD/non fatal MI/definite angina)

PAR for all combined *
30% 95% CI 10%-46%
adjusted for other predictors
29% 95% CI 9%-45%

*Population attributable risk
odds ratios adjusted for age, sex, employment grade

J Head et al, 2007
Causation

- Life course
- Behaviours
- Medical care
- Control
- Social supports
- Biology
POOR HEALTH IN HUNGARY BY SOCIA LRALLY* ORIENTED ITEMS

- 0-2 items
- 3-5 items
- 6-7 items

Odds ratio of poor health

Age-sex adjusted

Multivariate adjusted+

* colour tv, radio, record player, stereo system, motorbike, car, car radio
+ age, sex, educ, marital, material deprivation

Pikhart 2000
Causation

- Life course
- Behaviours
- Medical care
- Control
- Social supports
- Biology
ODDS RATIO* OF METABOLIC SYNDROME BY EXPOSURE TO ISO-STRAIN: WHITEHALL II PHASES 1 TO 5

*Adj. for age, employment, grade and health behaviours

Chandola, Brunner & Marmot, BMJ, 2006
MECHANISMS

- HYPOTHALAMIC PITUITARY AXIS (HPA) – CORTISOL
- SYMPATHETIC/PARASYMPATHETIC
CORTISOL AND SOCIAL STRESSORS IN PRIMATES

Adapted from: Abbott et al. Hormones and Behavior 43 (2003) 67-
CORTISOL AWAKENING RESPONSE AND EMPLOYMENT GRADE - WHITEHALL II

Increase in Salivary Cortisol (nmol)

<table>
<thead>
<tr>
<th></th>
<th>LOWER GRADES</th>
<th>HIGHER GRADES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wake + 30</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

(Kunz-Ebrecht et al. Psychoneuroendocrinology, 2004)
METABOLIC SYNDROME AND HEART RATE VARIABILITY: W II STUDY MEN

(Hemingway et al. Circulation, 2005)
The gradient
Poverty?
Not inevitable
Selection?
Causal pathways
Action
Commission on Social Determinants of Health
2005 - 2008

- Commissioners
- 9 Knowledge Networks
- Partner Countries
- Civil society work
- Global initiative
- WHO integration

Set up by the World Health Organisation

www.who.int/social_determinants
7th Commissioners meeting at WHO, Geneva, Jan 2007
Conceptualising the Social Determinants of Health

**SOCIAL CONTEXT**
- Natural Environment
- Norms & Values
- Governance
- Social Policies & Systems (e.g. education, health, labour, housing, social protection)
- Urbanisation
- Human Rights

**STRATIFICATION**
- Sex
- Ethnicity
- Place
- Education
- Occupation
- Income

**DIFFERENTIAL EXPOSURES & VULNERABILITIES**
- Material circumstances
- Psychosocial factors
- Behaviours
- Biological agents

**Average and differential health outcomes**
Policy Entry Points

- Social stratification – people’s social position related to their health
- Differential exposure to health damaging conditions
- Differential vulnerability
- Differential consequences of ill health
STATUS SYNDROME
HOW OUR SOCIAL STANDING AFFECTS OUR HEALTH AND LONGEVITY

MICHAEL MARMOT
STATUSSYNDROMET

HUR VÅR SOCIALA POSITION PÅVERKAR HÄLSAN OCH LIVSLÄNGDEN

Michael Marmot